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ABSTRACT

Keyboarding was taught to a group of 26 fourth- and fifth-grade students in a self-contained classroom by an elementary classroom teacher using an Apple IIe microcomputer and two software programs: "Gregg Personal Keyboarding" and "Typing Tutor II." Intervention spanned 52 class days, including pre-, mid-, and posttest days, with each student having approximately 10 minutes of computer time per day. Total time of computer use was approximately 520 minutes per child. The instructional goal of the intervention required that students reach a speed of 20 gross words per minute (gwpm) with three or less errors per minute. Students achieved a mean speed rate of 19.73 gwpm, with an error rate of 5.96 on the 46-word timed writing instrument. Keyboarding scores were examined for differences associated with grade level, sex, reading ability, student access to typewriter or computer at home, and ability to play the piano. (Author/RH)

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MASTER'S PROJECT

KEYBOARDING IN A SELF-CONTAINED FOURTH-FIFTH GRADE CLASSROOM

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Abstract

Keyboarding was taught to a group of 26 fourth and fifth grade students in a self-contained class room by the elementary class room teacher using an Apple IIe microcomputer and two software programs, Gregg Personal Keyboarding and Typing Tutor II. The project spanned 52 class days, including pre-, mid-, and post-test days, with students having approximately ten minutes of computer time per day. Total time on computer was approximately 520 minutes per child - less than nine hours. The goal for the project was that the students reach a speed of 20 gwpm with three or less errors per minute. Students achieved a mean speed rate of 19.73 gwpm, with an error rate of 5.96 on the 46-word timed writing. Hypotheses were set forth to examine the differences in keyboarding scores of fourth and fifth graders, boys and girls, high-ability and average-ability readers, those with access to typewriters or computers at home, and piano students and non-piano students.

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KEYBOARDING IN A SELF-CONTAINED FOURTH-FIFTH GRADE CLASSROOM

Computers have exploded upon the scene in the world of elementary education during the decade of the 80's. These computers, found in media centers, labs, and classrooms, as well as in the administrative offices of schools, are being used with young children for computer-assisted instruction, programming in LOGO and BASIC, and even in word-processing of children's creative stories.

Young children are having difficulty responding to some computer software programs because of their inability to quickly locate required keys on the computer's keyboard. This problem becomes even more pronounced when simple programming is taught, and words, phrases, and sometimes sentences must be input into the computer. Juvenile word-processing programs offer the possibilities of creative writing and revision on the computer, but this creativity is sometimes stifled by the difficulty children have in typing their stories into the computer.

Secondary business education teachers are concerned about the poor techniques students develop as a result of years of hunt-and-peck, two-finger typing in elementary school. "Any typewriting instructor who has experienced the challenge of retraining a typist under such conditions will readily admit that the task is difficult if not impossible"(Stewart & Jones, 1983, p. 11).

Computers are becoming available to more children now in their homes; and in some communities pressure is being put upon school systems to offer keyboarding, a form of typewriting, in elementary schools (Sormunen, 1984).

Problem Statement

Children need to be taught keyboarding basics by someone. Who is to offer keyboarding instruction: a business education teacher or the elementary teacher? Should it be taught in a lab or in the class room? How should it be taught?

Review of the Related Literature

Early Studies

Since literature on computer-assisted instruction (CAI) in keyboarding to elementary students is limited, a search into the literature on how typewriting (since it is so closely related to keyboarding) has been taught to elementary children has been included. The early studies focused on the effects typing had on children's achievement in school and the correlation of motor dexterity and language achievement.

Sinks and Thurston (1972) stated that over 900 studies were made between 1932 and 1972 which dealt in total or in part with the typewriter in classroom instruction. They cited Wood and Freeman's two-year study, "An Experimental Study of the Educational Influences of the Typewriter in the

Elementary Classroom: (1932), which was sponsored by a number of typewriter manufacturers in the United States and was carried out under different conditions in both public and private schools in all parts of the country.

> The results [of the Wood and Freeman study] indicated that children who used the typewriter advanced more rapidly in all subject matter in the elementary school than those children who did not use the typewriter. . . . There is fairly consistent evidence that the typewriter's influence on spelling is more favorable than on any other subject tested in the Stanford Achievement Test. (Sinks & Thurston, 1972, p. 345)

Sinks and Thurston (1972) also cited a study by Tate entitled "Use of the Typewriter in Remedial Reading and Language" (1942) which showed superior gains made in spelling and language usage by retarded intermediate grade school pupils.

The study published by Sinks and Thurston (1972) took place at Northern Illinois University during the summer of 1969. Eighteen third and fourth grade students were given six weeks of typing instruction on electric typewriters, and their achievement test scores on word meaning, spelling, word study skills, and language usage were compared to the achievement of eighteen students in a control group. The

subjects were matched on the basis of motor dexterity as determined by the Lincoln-Oseretsky Motor Development Scale. For a half hour on three days each week the experimental group was given instruction in typing by a classroom teacher while the control group was given experiences of a psychomotor nature in the gymnasium. The findings of this study were:

> In general, the study seems to support the findings of Wood and Freeman (1932) which concluded: "In grades three to six the partial correlation studies indicated that the total Stanford Achievement Test gains were positive but small." (Sinks & Thurston, 1972, p. 348)

The Sinks and Thurston study also found that students who had tested high on motor dexterity tests showed higher gains than low motor dexterity subjects. They concluded that ". . . the similarity of results [between language achievement and motor dexterity] strengthens the evidence already recorded that high motor dexterity and high mental age are positively correlated" (p. 348). They expressed a need to repeat the study using a longer time between the pretest and the post-test, in view of the brief time lapse involved in their study.

Perhaps the largest experiment in the elementary typewriting field was that of the Hawaii English Program (HEP), under which 50,000 children, ages 5 to 10 were using the electric typewriter to develop keyboard literacy in 1972. The HEP

underwent a five-year developmental period from 1966-1971; and the results of this program, mostly in K-3 classes, showed that children can learn to type using correct fingering in an individualized program using peer tutoring and teacher guidance.

Other data from the HEP showed that children ages 6 to 10 who had been typing one to four years typed up to 45 words per minute using the touch system. Learner achievement in the HEP was essentially independent of IQ and socioeconomic status. Three times as many girls were using advanced programs in the third year, but the sex difference did not show up during the first two tryout years (Okensendahl, 1972).

Recent Studies and Current Theory

Despite the positive results of elementary typewriting, particularly in the areas of language, spelling, and in remedial education, there have not been widespread adoptions of typewriting or keyboarding programs in elementary schools. The arrival of the microcomputer in the elementary school, however, is causing an increased need for keyboarding instruction. Several studies have been done to try to ascertain at what age it might be most beneficial to teach young children keyboarding skills, who should teach it, where it should be taught, and goals which should be set.

In 1983 Milly Cowles, Martha Hedley, and Mabel C. Robinson of the School of Education in the University of Alabama in Birmingham did a study entitled "An Analysis of

Young Children Learning Keyboarding Skills" in which children 5 to 8 years old were taught keyboarding skills in a summer school enrichment program. A secondary purpose was to examine the relationship between typing skill development and motor proficiency. Twenty-four children were included in the study, one group of twelve 5- and 6-year-olds and another group of twelve 7-and 8-year-olds. Subjects used IBM Selectric typewriters and a modified "Touch to Type Typing Program." All instruction was teacher-directed in 30-minute sessions and was continued for 19 days. Each lesson was observed by at least one child development specialist in order to measure time-on-task behaviors and to search for obvious signs of frustration, enjoyment, and perserverance.

> Results indicated that young children can learn to type correctly, and they can do so without frustration. Seven- and eight-year-olds experienced success with words and sentences and stayed with the task; five- and six-year-olds progressed to words only. Observations suggested that being able to read was an important antecedent skill. Additional results showed that gross and fine motor proficiency were highly related to the success of the older children. (Cowles et al., 1983, p. 1)

Upon examination of data included in the Cowles et al. (1983) study, the speed goals of the subjects ranged from six gross

words per minute for the five-year-olds to ten gross words per minute for the seven- and eight-year-olds. The accuracy goal was for no more than one-third of the strokes to be in error for all age groups. The timed-writing test was for only thirty seconds and included only key strokes and words on the home row for five- and six-year-olds and a few keys off the home row with words and sentences for the seven- and eight-year-olds.

Evelyn Kisner, Director of Business Education of the Texas Education Agency, proposes: "Keyboarding should be taught prior to the grade level where students begin using computers for academic work, with a goal of mastery of the keyboard before students begin working with software programs of instruction" (Kisner, 1984, p. 21). She further states that mastery is to be achieved by "correct posture at the machine, proper techniques for striking keys, accurate fingering of keys, and operation of basic machine parts." She recommends that for kindergarten through Grade 3 that an achievement of 20 words a minute with accuracy could be considered adequate for responding to software instructions. She believes most students should be able to achieve this rate in four or five weeks, but does not give a suggestion for length of lesson or methodology. For Grades 4 through 6, she suggests an achievement goal of 25 words a minute, with accuracy, because input at that level often calls

for sentences. As with the lower grades, she does not set forth length of lesson or methodology, nor does she specify an estimate of time in weeks that it might take to achieve this goal for this particular grade level. Kisner advocates teamwork between business education teachers and elementary teachers to provide instruction in teaching keyboarding skills but does not elaborate on how this difficult task might be accomplished.

Carolee Sormunen in an article in the Journal of Business Education (October, 1984) offers a suggestion to the dilemma of business education teachers or elementary teachers for keyboarding instruction. She advocates inservice training for the elementary teachers to be given by the business educators, and she sets forth the steps in this process beginning with the first step of "approaching the administrative staff about the need for an articulated program of keyboarding and typing instruction at all levels of the school system" (p. 15).

Lawrence Erickson of the Graduate School of Education, UCLA, has written concerning performance goals at the elementary level for typewriting and/or keyboarding. He stresses the most important aspect of teaching elementary pupils is that they know and understand specified goals and what is expected of them. He states it may also be necessary to adapt a stated performance goal to the needs of an individual pupil as well as the needs of the group. He stresses another important characteristic of the elementary typist:

> At the elementary school level, especially, the learner has a tremendous need to explore, to discover, to try out - all without worry about errors. If these needs are suppressed because of a concern for accuracy, for example, then the slow, plodding typist emerges. When these needs of elementary school pupils are exploited in the teaching-learning situation, then the learning energies of the pupils are liberated and they achieve at new and higher levels--as a matter of fact, at levels which are equal to those achieved by typing students at other levels. (Erickson, 1972, p. 20)

In addressing the issue of computer-assisted instruction in keyboarding, Erickson in Century 21 Reporter (Fall, 1983) calls for research to indicate the effectiveness in relation to the cost of microcomputer use for teaching of keyboarding skills. He feels the initial "action research" seems to indicate that software programs cannot do the job alone. "Teacher monitoring and assistance seem necessary if maximum learning is to occur" (p. 7).

Stewart & Jones (1983) stated that the public schools of Lincoln, Nebraska, have recognized the need for keyboarding instruction, and four options which utilize the business education teacher are being considered for teaching keyboarding:

1. Elective courses in summer school. Tuition would be charged and transportation would be required, since students must be transported to the high schools where the only electric typewriters in the system are available.

2. Evening or late afternoon classes at the high school. Parents would be required to provide transportation.

3. Use of senior high facilities at other times (8:00 to 8:30 or 12 noon to 1 p.m.) This option would require bussing of students.

4. Taking the machines and teacher to the elementary school. This would require a traveling teacher as well as the purchase of a room of electric typewriters or microcomputers.

"The keyboarding course would be required for grades four, five, and six and might be optional for third graders. The class period would be 30 minutes and the course would be for four or five weeks" (Stewart & Jones, 1983, p. 12).

The above plan is based on the theory that typewriting or keyboarding instruction can only be taught by a certified business education teacher. This school system does not seem to have investigated the possibility of training (perhaps by in-service workshops) elementary teachers to teach keyboarding by CAI, thereby eliminating the need for bussing of students, a traveling teacher and equipment, or putting the burden of transportation for a required course of study upon the parents (which seems to be inconsistent with the idea of "free" public education.)

Keith Wetzel of the University of Oregon (1985) thinks regular classroom teachers should instruct elementary students. He quotes Peggy Kennedy, formerly of the Minnesota Curriculum Services Center, that "teachers who type can be trained in as little as one day to teach keyboarding and even those who do not type may be trained in as little as five weeks." He believes that Kisner's 25 gross words per minute goal is not a realistic entry-level goal for students and that 10 gross words per minute will enable a child to make adequate use of the computer. Wetzel recommends keyboarding instruction before Grade 6. He sets forth two models for elementary keyboarding instruction, a classroom arrangement and a lab arrangement, giving advantages of each. Wetzel's models require 20 days of instruction for 35 minutes each day--less than twelve hours.

Tonja Caster, in her paper "The Use and Effectiveness of Computers in the Elementary Classroom" (1983), gives practical suggestions for the use of computers in the classroom and offers suggestions for where to locate the computer in relation to electrical sockets, windows, chalkboards, program sound, classroom traffic patterns, and size of groups at computer. She recommends software programs, including two possible programs for keyboarding instruction, Keyboard for younger children, and Master Type, slightly more difficult, as well as Bank Street Writer for word processing and The Story Machine, a program that encourages creative writing at the computer.

Caster cites research that has found CAI more effective than traditional methods for teaching reading, vocabulary, and language, and also cites a study by Woodruff and Bereiter (1981-82) which used CAI for writing and in which the findings were mixed:

> Results showed that the computer took significantly more time than using paper and pencil because of the time spent using the computer. . . . However, students indicated that they liked writing using the computer significantly better than using paper and pencil and that it was easier to write on the computer. (Caster, 1983, p. 13)

An investigation of the actual CAI writing study revealed "subjects had little or no experience with typing and no experience with computers" (Woodruff, Bereiter & Scardamalia, 1981, p. 137). Could this have had something to do with the findings of the study? Would the results have been different if the students had had keyboarding experience?

New Technology and Keyboarding Software Reviews

Holly Brady, editor of Classroom Computer Learning, (1984) has summarized some reasons for teaching keyboarding to students. She sets forth the interesting question of whether or not now is the time to switch to the Dvorak keyboard rather than continue with the old-fashioned QWERTY keyboard. She reports that the Apple company has announced that its new Apple IIc

will come equipped with rearrangeable key caps and a simple switch that changes a QWERTY to a Dvorak keyboard and offers a suggestion that young children who are simply running menu-driven software use a keyboard with ABC's lined up in a row. This would only require that a simple chip be substituted for another.

Albert C. Kolb explained the rationale behind today's QWERTY keyboard and the advantages of August Dvorak's keyboard in the September, 1984, issue of Classroom Computer Learning. The Dvorak keyboard places vowels on the left side of the home row and the most frequently used consonants on the right side of the home row. Kolb stated that a microcomputer chip is now available for the Apple II or II Plus which allows students to select from among eight keyboards--including two for handicapped students confined to use of either hand, and one in alphabetical order.

An evaluation of seven computer programs for use in teaching keyboarding is also included in the September, 1984, issue of Classroom Computer Learning. Linda Roehrig Knapp has divided the programs into three divisions: comprehensive tutorials, short tutorials, and game-format tutorials. She provides information on publisher, hardware needed, price, grade levels, on-screen instruction, typing practice, feedback to learner, whether both upper and lower case letters are available, whether the user can correct errors, and whether

the teacher can create lessons. The seven programs evaluated were Gregg Keyboarding for Information Processing, Alphabetic Keyboarding, Typing Strategy, Typing Tutor, Letter-Man, Master Type, and Type Attack.

Synthesis

The review of the literature on elementary typewriting and computer-assisted instruction of keyboarding revealed no documented studies similar to the one set forth below which taught keyboarding by means of a classroom microcomputer to a self-contained class of fourth and fifth graders. The literature did provide, however, studies that showed that keyboarding skills increase achievement in language arts, Wood and Freeman (1932), Tate (1942), Sinks and Thurston (1972); and articles that recognized the need for keyboarding instruction, Brady (1984), Stewart & Jones (1983), Sormunen (1984), and Wetzel (1985). The search revealed a study where keyboarding knowledge might have changed the findings, Woodruff et al. (1981-82), in a writing program that seemed to have great potential. Options were found for teaching keyboarding by using high school facilities and business education teachers, Stewart & Jones (1983); a plan for inservice training in keyboarding to be offered to elementary teachers was provided, Sormunen (1984); and Wetzel (1985) proposed two models for the teaching of keyboarding by elementary teachers. Methodology and typing achievement were documented, Oksendahl (1972) and Cowles et al.(1983); and Kisner (1984) set forth mastery goals for specific grade levels, while Wetzel proposed minimum goals.

Erickson (1972) stressed the need for students' knowledge of goals set and characteristics of elementary typists, as well as the importance of teacher monitoring and assistance in conjunction with computer-assisted instruction (1983). Tonja Caster (1983) gave practical suggestions for use of a computer in the classroom, while Brady (1984) and Kolb (1984) explained new computer technology that can allow different keyboards. Computer software suitable for the teaching of keyboarding was reviewed by Caster (1983) and Knapp (1984).

Elements from many of the above references were helpful in designing the instructional model used in the study described below.

Description of the Project

Purpose

The primary purpose of this study was to determine what results could be accomplished in keyboarding instruction with limited resources; i. e., one computer for 26 children in a self-contained fourth-fifth grade classroom and in a limited time span (less than 60 days). No special funding was awarded for the project, which was conducted at the Lindley Park Elementary School in Asheboro, North Carolina, with permission granted by the principal and school system. Parental permission to participate was requested also. The Apple IIe computer was the personal property of the researcher, and all materials used were either available through the school's

media center or purchased by the researcher. The project was conducted between March 11 and June 5, 1985, for an actual number of 52 class days.

This keyboarding project was conducted upon the belief by the researcher that the greatest potential for the use of the microcomputer in the intermediate grades is in the area of writing. Children hate the revision of writing, as most adults do, and many children are further handicapped by illegible handwriting. Producing a neat, legible final copy of their work in ink is almost an impossibility for many children. A first step in this computer writing program would be basic keyboarding to be followed by the second step of word processing.

Student Population

The student composition in the fourth-fifth grade class was 13 boys and 12 girls, with one boy who was mainstreamed from an emotional-handicapped class, making a total of 26 students. Twelve students were fourth graders, and 14 were fifth graders. Seven children were of racial minority origin. All students were of average or above-average ability. Socioeconomic status of the children ranged from low income to moderately-high income, with the majority in the average income range. These students had had no previous instruction in keyboarding, but they had used microcomputers in the media center for CAI on a limited basis for two years.

Goals and Objectives

Goals and objectives were set after a review of related literature and by the choice of tutorial software (Gregg Personal Keyboarding) which set forth goals within the program. The stated objective for the keyboarding project was:

> Students will achieve a speed goal of 20 gross words per minute with three or less errors per minute.

This speed goal was lower than Kisner (1984) had recommended (25 gwpm), but higher than the minimum goal that Wetzel (1985) had believed to be adequate (10 gwpm). The stated speed goal within the Gregg Personal Keyboarding software program was 20 gwpm. The accuracy goal was also determined from the software program, but was given less emphasis in the study than speed, upon the recommendation of Erickson (1972) that for elementary students accuracy was less important than speed. Kisner (1984), however, stated her goals with accuracy; therefore, an accuracy goal was included in this study.

Hypotheses

As a secondary purpose to this study, the following related issues were put forth as hypotheses:

Hypothesis 1: There will be no significant difference between the keyboarding scores of boys and girls in the study. According to the HEP project, the difference in boys' and girls' scores did not show up until the third year of the program.

Hypothesis 2: There will be no significant difference between the keyboarding scores of the fourth and fifth graders in the study. Although the younger children in the Cowles et al. study had a fairly wide range between the two groups, the scores were not analyzed for statistical difference. It is further believed that there would be less difference in motor dexterity ability between these two older groups than in the two groups of younger children.,

Hypothesis 3: There will be no significant difference in the keyboarding scores of those children who have access to a typewriter or computer at home and in those who do not have a typewriter or computer at home. It was recommended that those who had a typewriter or computer at home practice whenever possible, but practice was not required.

Hypothesis 4: There will be no significant difference in the keyboarding scores of those children of high reading ability (85th percentile and higher) and those of average-reading ability (40th to 84th percentile) as measured by the California Achievement Test (CAT). In the Cowles et al. study with the younger children, it was believed that reading was an important antecedent skill to typing. What effect would proficiency in reading have upon typing ability?

Hypothesis 5: There will be no significant difference in the keyboarding scores of those children who have had or are taking piano lessons and in those who have not had piano

lessons. The studies by Sinks and Thurston (1972) and Cowles et al. (1983) revealed that motor proficiency and dexterity were related to success in the typing experiments and achievement. No specific length of time period of piano lessons was required for inclusion in the piano lesson group. Having had piano lessons would indicate prior exercising of the same finger muscles required for typing.

All hypotheses were to be tested for significance by means of a t test at the $p < .05$ level.

Assumptions

The following assumptions were made concerning this keyboarding study:

1. Keyboarding can be taught by the elementary class room teacher who is trained in typing to all students in the class using a microcomputer and tutorial software.

2. All children in the class will benefit from receiving instruction in keyboarding by increasing efficiency in the use of the microcomputer (literacy) and by greater potential for academic success in the area of language arts, as was indicated from past studies.

Definitions of the Terms

"Keyboarding" has been defined in several ways, ranging from a simple definition: "the popular term is 'learn to type'" (Cowles et al, 1983, p. 15) to one that is more complex: "Keyboarding is inputting information--accurately

and efficiently--into various types of equipment through the use of a typewriter-like keyboard (Hanson & Rigby, 1981).

Erickson (1983) explained the difference between typewriting and keyboarding:

> Typewriting is that activity involving the manipulation of the keys and controls of a standard typewriter keyboard in such a manner that typed copy (referred to as "hard copy") is produced on paper. Keyboarding is that activity involving the manipulation of the keys and controls of a standard typewriter-like keyboard to produce copy which appears either on a display screen or is recorded and stored in memory for later access and use. "Hard copy" is not the immediate product. (Erickson, 1983, p. 5)

For the purposes of this study, a "self-contained" class room is one that is under the control of one teacher in the same physical class room for the major part of the school day.

In this study keyboarding scores for speed are expressed as gross words per minute. (Gross words per minute is figured by dividing total keystrokes per minute by five, with no adjustment for errors.) Scores for speed and accuracy were computed by the software program Typing Tutor II, which was used as the testing instrument.

Limitations of the Study

There will be no children included in this project who are reading well below their grade level, and the size of the population (26) is small, although representative of the number in the typical elementary class. The amount of time which could be allotted to each child per day on the computer was only 10 minutes, much less than in any previous study analyzed, thereby increasing the amount of time needed to teach keyboarding. A typical class schedule has blocks of time for lunch, physical education, art, and music which require the entire class to participate. Furthermore, while no elementary class room setting is a perfect laboratory without outside interruptions and distractions, the time frame of this research project was especially fragmented by field trips, assembly program practices, achievement testing, and other special events occurring during the last weeks of a school year.

Methodology

This keyboarding project was conducted using an Apple IIe microcomputer, tutorial software, teacher instruction, and peer tutoring. Questionnaires were completed by parents, giving information on computer/typewriter access at home and whether or not students had received piano lessons. Before instruction began, a pretest was administered to determine entry level performance and scores were recorded.

Tests were again administered and recorded on the 30th day and the 52nd day of the project.

Tutorial Software

Two software programs were used in the keyboarding project: Gregg Personal Keyboarding, produced by Gregg/McGraw Hill & Control Data Corporation and adapted from Keyboarding for Information Processing; and Typing Tutor II by Microsoft. (A third program Master Type was considered for enrichment in the project, but limited time would not allow for its inclusion.) Gregg Personal Keyboarding was chosen as the primary tutorial due to its letter-by-letter presentation and on-screen display of correct fingering and keystrokes. The main weakness of this program was its lack of management system and lack of exact calculation of timed writings. A sentence would be presented to the student to type, and timing would begin. At the end of the timed period, the student could no longer type on the drill and would be informed whether or not he had achieved the stated goal of 20 words per minute with three or fewer errors. The student could then repeat the drill until he reached the objective. Due to the fact that there was no management system or accurate testing on the Gregg Personal Keyboarding program, Typing Tutor II was used for management and testing but was rejected as the primary instructional tool, because of its too-fast presentation of keys, lack of on-screen display of correct fingering and keystrokes, and lack of stated objective to the

student. The main difficulty in using these different programs for testing and instructing was that Gregg Personal Keyboarding required error correction while Typing Tutor II would not allow error correction.

Master Type would have been an excellent supplemental teaching aid, as its game format is highly motivating. It would not have been satisfactory as the primary instructional instrument since it did not progress beyond the word level of typing. It is an intense game and can be extremely frustrating; therefore it is not recommended for beginners.

Pretest

The 26 students who participated in the keyboarding project were given the intermediate test on the Typing Tutor II program, which was a 46-word writing. Although these students had had no previous keyboarding instruction, they had all used microcomputers in the school's media center for CAI,and a few had personal computers at home. The class mean for speed on the pretest was 10.73 gwpm, and the accuracy mean was 14.35 errors. It is interesting to note that the class mean (10.73 gwpm) was equal to Wetzel's (1985) minimum keyboarding goal.

Instruction

Instruction was given by the classroom teacher to the entire class when a new key was introduced. Students had been given cardboard keyboards and would practice correct fingering at their desks. A large wall chart was kept on which each

new key was recorded as it was presented, giving students a visual record of their progress. While the actual lesson presentation time varied according to the new key presented and the amount of review, it usually ranged from five to ten minutes.

Students were assigned a ten-minute block of time each day in which to practice the lesson. They were responsible for watching the clock and going to the computer without teacher prompting. Due to the short practice time of ten minutes per student, two days' practice were allotted for each new key.

Peer Tutoring

In order to help assure correct fingering and techniques, a system of peer tutoring was devised to supplement the monitoring of students by the teacher. When a student finished his turn, he remained at the computer for approximately five minutes while the next student worked, helping the new student with correct fingering and techniques. This system helped to overcome the time delay problem between teacher instruction and student practice.

Findings

Mid-Project Test (30th Day)

Students were again given the intermediate test on the Typing Tutor II disk. The class mean for speed was 15.42 gwpm, and the accuracy mean was 13.35 errors. Most of the more frequently-used keys had been presented by this time;

however, there were still instances where students had to use the hunt-and-peck system for keys not yet introduced in class.

Posttest (52nd Day)

The final test was given on the 52nd day, having allowed one day to practice for the test on Typing Tutor II, since the method of handling errors differed between the two programs used in the project. (A few students scored better on the practice day than on the posttest; however, only the scores for the 52nd day were included in the final data.) The students were allowed to have two chances on the test. After the first test, they were instructed to record the test data and then re-take the test. If the second trial showed a better score than the first, they were to record the second score. If the first test was best, they were asked not to record the second writing.

The class mean for speed was 19.73 gwpm, and the mean for accuracy was 5.96 errors. The class objective for speed was missed only by hundredths of a point, while the objective for accuracy was met. (If the student typed the writing at 20 gwpm, he would complete the test in 2.3 minutes. The accuracy goal would be reached if he made no more than six errors.)

Nine of the 26 students who participated in the project reached both the speed and accuracy goals (35%). Twelve students (46%) met the speed goal, and nineteen students (73%) achieved the accuracy goal. All members of the class scored at least 10 gwpm, the minimal goal set by Wetzel (1985).

The action taken on the hypotheses on related issues is as follows:

Hypothesis 1: The mean speed score of the girls in the study was 21.17 gwpm, and the mean for the boys was 18.5 gwpm (t (11) = 2.20, $p < .05$). Although the girls' score was higher, it was not statistically significant.

The mean accuracy score for the girls was 5.25 errors, and the mean accuracy score for the boys was 6.57 errors. Although the girls were also more accurate, the difference was again not statistically significant.

Hypothesis 1 was not rejected.

Hypothesis 2: The mean speed score of the fourth graders was 20.58 gwpm, and the mean speed score of the fifth graders was 19 gwpm (t (11) = 2.20, $p < .05$). There was no significant difference in the two means for speed.

The mean accuracy score for the fourth grade was 6.08 errors, and the mean accuracy score for the fifth graders was 5.86 errors. It is interesting to note that the fourth graders were faster, but the fifth graders were more accurate.

There was, however, no statistically significant difference in the two means.

Hypothesis 2 was not rejected.

Hypothesis 3: The mean speed score of those who had access to a typewriter or computer at home was 21.64 gwpm, and the mean score of those who did not have access to a typewriter or computer at home was 18.33 gwpm (t (10) = 2.23, $p < .05$). Although those who did have access had higher scores, the difference between the means was not statistically significant.

The mean accuracy score for those who had access to a typewriter or computer at home was 5.64 errors, and the mean accuracy score for those who did not have access to a typewriter or computer at home was 6.2 errors. Those who had access were more accurate, but the difference in the means was not statistically significant.

Hypothesis 3 was not rejected.

Hypothesis 4: The mean speed score of those of high reading ability (85th percentile and above) was 18.5 gwpm, and the mean speed score of those of average reading ability (40th to 84th percentile) was 20.5 gwpm (t (9) = 2.26, $p < .05$). There was no statistically significant difference between the means.

The mean accuracy score for those of high reading ability was 4.3 errors, and the accuracy mean for those of average reading ability was 7. The students of high reading ability were significantly more accurate than those of average reading ability.

Hypothesis 4 was rejected due to the statistically significant difference between the accuracy of the two groups.

Hypothesis 5: The speed mean of those who had had or were taking piano lessons was 21.5 gwpm, and the mean for those who had not had piano lessons was 19.41 (t (3) = 3.18, $p < .05$). Although the piano players had a higher speed mean, the difference was not statistically significant.

The accuracy mean of those who had had or were taking piano lessons was 4 errors, and accuracy mean of those who had not had piano lessons was 6.32 errors. The piano players were also more accurate, but not statistically significantly so.

Hypothesis 5 was not rejected.

Evaluation

The students in the project did learn keyboarding skills, and they learned them in the elementary classroom taught by an elementary teacher using a microcomputer and tutorial software. The class mean barely missed the speed goal of 20 gwpm by tenths of a point (19.73) and did reach the accuracy goal of three errors or less per minute. Nothing in the already crowded curriculum of the elementary grades was supplanted. Total time on the computer, including pretesting and post-testing, was approximately 520 minutes--less than 9 hours!

The lack of significant differences between student groups in the findings of four of the five hypotheses serves to support the assumption that all children will benefit from

keyboarding instruction--not just certain groups of children. Cases can be made that academically gifted children would benefit from this enrichment and would not suffer from missing some basic classes to achieve it, or that learning disabled children--many of whom have illegible handwriting--could benefit through experiencing a new pride in their work, or any number of other categories of children would benefit in some special way. The study set forth above provides that all students can benefit without loss of any other basic subject and offers the possibiltiy of pride in neat legible work to all students. Many schools which have a sufficient number of computers (one or more per grade level) could implement this project with minimal in-service teacher training.

There were weaknesses, however, within the program that need correction or modification. One of these weaknesses was in the lack of compatibility of the two software programs used. A better solution would be to find one program which would contain all the strong features of the two tutorials used: a management system, with pre-, mid-, and post-tests; letter-by-letter presentation of keys, location drills, word drills, and sentence practice; frequent feedback about typing accuracy and speed; and a game option which would challenge and motivate students to increase speed and accuracy.

Another weakness in this project was the short amount of time allotted to students on the computer. Either extending

the number of days to 90 (half a year) or adding a second computer to each class to allow 20 minutes per day per student and keeping the length of program to approximately 60 days would enable the students to achieve the 25 gwpm mastery goal advocated by Kisner and would enable them to make use of their newly-acquired keyboarding skills by learning word processing and using it in conjunction with the writing curriculum.

After the posttest, the students in this project were given an opportunity to use a juvenile word processing program to type one of their creative stories written during the school year. Time did not allow for adequate exploration in this new medium of writing revision before the end of the school year in early June. There are many good software programs now available to encourage creative writing, and those students who have keyboarding skills will benefit greatly from using these programs. Furthermore, if early research in the elementary typewriting area is generalizable to today's world, those students who can and do make use of keyboarding skills should improve in language arts (particularly in spelling).

Other studies need to be done offering alternative formats for elementary keyboarding, through the media center or a lab, and using new improved software as it becomes available.

KEYBOARDING SCORES (SEX)

	Pretest		Midtest		Posttest	
Girls	GWPM	Err.	GWPM	Err.	GWPM	Err.
Tammy G.	8	16	14	5	20	9
Fermena H.	9	70	28	4	19	5
Brandie H.	9	10	11	8	26	4
Lori K.	13	4	16	3	28	5
Dayna M.	8	3	21	4	15	7
Ayanna P.	13	23	13	9	28	6
Tina H.	10	16	17	12	15	9
Freda M.	11	8	16	23	16	6
Jenny M.	6	13	13	6	26	4
Julie M.	13	24	14	9	15	5
Maria M.	14	8	11	2	21	2
Cindy G.	8	27	10	3	25	1
Means	(10.17)	(18.5)	(15.33)	(7.33)	(21.17)	(5.25)
Boys						
Anthony F.	14	15	14	6	14	8
Shawn I.	15	6	22	41	20	11
David P.	11	14	12	7	17	6
Greg S.	9	13	9	8	23	5
Jason V.	14	20	13	4	21	3
John R.	14	7	23	75	16	4
Steve B.	16	12	19	14	18	3
Demetrice C.	11	15	23	20	19	25
Ross H.	9	2	14	20	30	9
Mark R.	11	11	10	27	10	6
Jason S.	10	6	11	6	28	4
Chad T.	7	3	19	2	13	3
Brad W.	8	19	15	18	17	3
David W.	8	8	13	11	13	2
Means	(11.21)	(10.79)	(15.5)	(18.5)	(18.5)	(6.57)
CLASS MEANS	(10.73)	(14.35)	(15.42)	(13.35)	(19.73)	(5.96)

KEYBOARDING SCORES (GRADE)

	Pretest		Midtest		Posttest	
Fourth Grade	GWPM	Err.	GWPM	Err.	GWPM	Err.
Anthony F.	14	15	14	6	14	8
Tammy G.	8	16	14	5	20	9
Fermena H.	9	70	28	4	19	5
Brandie H.	9	10	11	8	26	4
Shawn I.	15	6	22	41	20	11
Lori K.	13	4	16	3	28	5
Dayna M.	8	3	21	4	15	7
Ayanna P.	13	23	13	9	28	6
David P.	11	14	12	7	17	6
Greg S.	9	13	9	8	23	5
Jason V.	14	20	13	4	21	3
John R.	14	7	23	75	16	4
Means	(11.41)	(16.75)	(16.33)	(14.5)	(20.58)	(6.08)
Fifth Grade						
Steve B.	16	12	19	14	18	3
Demetrice C.	11	15	23	20	19	25
Ross H.	9	2	14	20	30	9
Tina H.	10	16	17	12	15	9
Freda M.	11	8	16	23	16	6
Jenny M.	6	13	13	6	26	4
Julie M.	13	24	14	9	15	5
Maria M.	14	8	11	2	21	2
Mark R.	11	11	10	27	10	6
Jason S.	10	6	11	6	28	4
Chad T.	7	3	19	2	13	3
Brad W.	8	19	15	18	17	3
David W.	8	8	13	11	13	2
Cindy G.	8	27	10	3	25	1
Means	(10.14)	(12.29)	(14.64)	(12.36)	(19)	(5.86)
CLASS MEANS	(10.73)	(14.35)	(15.42)	(13.35)	(19.73)	(5.96)

KEYBOARDING SCORES (ACCESS)

	Pretest		Midtest		Posttest	
Access	GWPM	Err.	GWPM	Err.	GWPM	Err.
Tammy G.	8	16	14	5	20	9
Brandie H.	9	10	11	8	26	4
Lori K.	13	4	16	3	28	5
Ayanna P.	13	23	13	9	28	6
Greg S.	9	13	9	8	23	5
Jason V.	14	20	13	4	21	3
Steve B.	16	12	19	14	18	3
Ross H.	9	2	14	20	30	9
Tina H.	10	16	17	12	15	9
Freda M.	11	8	16	23	16	6
Chad T.	7	3	19	2	13	3
Means	(10.82)	(11.55)	(14.64)	(9.82)	(21.64)	(5.64)
No Access						
Anthony F.	14	15	14	6	14	8
Fermena H.	9	70	28	4	19	5
Shawn I.	15	6	22	41	20	11
Dayna M.	8	3	21	4	15	7
David P.	11	14	12	7	17	6
John R.	14	7	23	75	16	4
Demetrice C.	11	15	23	20	19	25
Jenny M.	6	13	13	6	26	4
Julie M.	13	24	14	9	15	5
Maria M.	14	8	11	2	21	2
Mark R.	11	11	10	27	10	6
Jason S.	10	6	11	6	28	4
Brad W.	8	19	15	18	17	3
David W.	8	8	13	11	13	2
Cindy G.	8	27	10	3	25	1
Means	(10.67)	(16.4)	(16)	(15.93)	(18.33)	(6.2)
CLASS MEANS	(10.73)	(14.35)	(15.42)	(13.35)	(19.73)	(5.96)

KEYBOARDING SCORES (READING)

	Pretest		Midtest		Posttest	
RP Above 84	GWPM	ERR.	GWPM	Err.	GWPM	ERR.
Fermena H.	9	70	28	4	19	5
Dayna M.	8	3	21	4	15	7
Jason V.	14	20	13	4	21	3
Freda M.	11	8	16	23	16	6
Julie M.	13	24	14	9	15	5
Lori K.	13	4	16	3	28	5
Jason S.	10	6	11	6	28	4
Chad T.	7	3	19	2	13	3
Brad W.	8	19	15	18	17	3
David W.	8	8	13	11	13	2
Means	(10.1)	(16.5)	(16.6)	(8.4)	(18.5)	(4.3)
RP Below 85						
Anthony F.	14	15	14	6	14	3
Tammy G.	8	16	14	5	20	9
Brandie H.	9	10	11	8	26	4
Shawn I.	15	6	22	41	20	11
Ayanna P.	13	23	13	9	28	6
David P.	11	14	12	7	17	6
Greg S.	9	13	9	8	23	5
John R.	14	7	23	75	16	4
Steve B.	16	12	19	14	18	3
Demetrice C.	11	15	23	20	19	25
Ross H.	9	2	14	20	30	9
Tina H.	10	16	17	12	15	9
Jenny M.	6	13	13	6	26	4
Maria M.	14	8	11	2	21	2
Mark R.	11	11	10	27	10	6
Cindy G.	8	27	10	3	25	1
Means	(11.13)	(13)	(14.69)	(16.44)	(20.5)	(7)
CLASS MEANS	(10.73)	(14.35)	(15.42)	(13.35)	(19.73)	(5.96)

KEYBOARDING SCORES (PIANO)

	Pretest		Midtest		Posttest	
Piano Lessons	GWPM	Err.	GWPM	Err.	GWPM	Err.
Jason V.	14	20	13	4	21	3
Freda M.	11	8	16	23	16	6
Lori K.	13	4	16	3	28	5
Maria M.	14	8	11	2	21	2
Means	(13)	(10)	(14)	(8)	(21.5)	(4)
No Piano Lessons						
Anthony F.	14	15	14	6	14	8
Tammy G.	8	16	14	5	20	9
Fermena H.	9	70	28	4	19	5
Brandie H.	9	10	11	8	26	4
Shawn I.	15	6	22	41	20	11
Dayna M.	8	3	21	4	15	7
Ayanna P.	13	23	13	9	28	6
David P.	11	14	12	7	17	6
Greg S.	9	13	9	8	23	5
John R.	14	7	23	75	16	4
Steve B.	16	12	19	14	18	3
Demetrice C.	11	15	23	20	19	25
Ross H.	9	2	14	20	30	9
Tina H.	10	16	17	12	15	9
Jenny M.	6	13	13	6	26	4
Julie M.	13	24	14	9	15	5
Mark R.	11	11	10	27	10	6
Jason S.	10	6	11	6	28	4
Chad T.	7	3	19	2	13	3
Brad W.	8	19	15	18	17	3
David W.	8	8	13	11	13	2
Cindy G.	8	27	10	3	25	1
Means	(10.32)	(15.14)	(15.68)	(14.32)	(19.41)	(6.32)
CLASS MEANS	(10.73)	(14.35)	(15.42)	(13.35)	(19.73)	(5.96)

t test

Hypothesis 1

Keyboarding Scores by Sex

Girls Speed Scores

X	$\bar{X}$	x	x^2
20	21.17	-1.17	1.37
19	21.17	-2.17	4.71
26	21.17	4.83	23.33
28	21.17	6.83	46.65
15	21.17	-6.17	38.07
28	21.17	6.83	46.65
15	21.17	-6.17	38.07
16	21.17	-5.17	26.73
26	21.17	4.83	23.33
15	21.17	-6.17	38.07
21	21.17	- .17	.03
25	21.17	3.83	14.67
			301.68

$S = \sqrt{\frac{301.68}{11}} = \sqrt{27.43} = 5.24$

$Sm = \frac{5.24}{3.46} = 1.51$

$\mu = 21.17 \pm (2.20)(1.51)$

$= 21.17 \pm 3.32$

$= 17.85$ to 24.49

Boys Mean = 18.5

Girls Accuracy Scores

X	$\bar{X}$	x	x^2
9	5.25	3.75	14.06
5	5.25	-- .25	.06
4	5.25	-1.25	1.56
5	5.25	- .25	.06
7	5.25	1.75	3.06
6	5.25	.75	.56
9	5.25	3.75	14.06
6	5.25	.75	.56
4	5.25	-1.25	1.56
5	5.25	- .25	.06
2	5.25	-3.25	10.56
1	5.25	-4.25	18.06
			64.22

$S = \sqrt{\frac{64.22}{11}} = \sqrt{5.84} = 2.42$

$Sm = \frac{2.42}{3.46} = .70$

$\mu = 5.25 \pm (2.20)(.70)$

$= 5.25 \pm 1.54$

$= 3.71$ to 6.79

Boys Mean = 6.57

t test

Hypothesis 2

Keyboarding Scores by Grade

Fourth Grade Speed Scores

X	$\bar{X}$	x	x^2
14	20.58	-6.58	43.30
20	20.58	- .58	.34
19	20.58	-1.58	2.50
26	20.58	5.42	29.38
20	20.58	- .58	.34
28	20.58	7.42	55.06
15	20.58	-5.58	31.14
28	20.58	7.42	55.06
17	20.58	-3.58	12.82
23	20.58	2.42	5.86
21	20.58	.42	.18
16	20.58	-4.58	20.98
			256.96

$S = \sqrt{\frac{256.96}{11}} = \sqrt{23.36} = 4.83$

$Sm = \frac{4.83}{3.46} = 1.40$

$\mu = 20.58 \pm (2.20)(1.40)$

$= 20.58 \pm 3.08$

$= 17.5$ to 23.66

Fifth Grade Mean = 19

Fourth Grade Accuracy Scores

X	$\bar{X}$	x	x^2
8	6.08	1.92	3.69
9	6.08	2.92	8.53
5	6.08	-1.08	1.17
4	6.08	-2.08	4.33
11	6.08	4.92	24.21
5	6.08	-1.08	1.17
7	6.08	.92	.85
6	6.08	- .08	.01
6	6.08	- .08	.01
5	6.08	-1.08	1.17
3	6.08	-3.08	9.49
4	6.08	-2.08	4.33
			58.96

$S = \sqrt{\frac{58.96}{11}} = \sqrt{5.36} = 2.32$

$Sm = \frac{2.32}{3.46} = .67$

$\mu = 6.08 \pm (2.20)(.67)$

$= 6.08 \pm 1.47$

$= 4.61$ to 7.55

Fifth Grade Mean 5.86

t test

Hypothesis 3

Keyboarding Scores by Access

Student Access Speed Scores

X	$\bar{X}$	x	x^2
20	21.64	-1.64	2.69
26	21.64	4.36	19.01
28	21.64	6.36	40.45
28	21.64	6.36	40.45
23	21.64	1.36	1.85
21	21.64	- .64	.41
18	21.64	-3.64	13.25
30	21.64	8.36	69.89
15	21.64	-6.64	44.09
16	21.64	-5.64	31.81
13	21.64	-8.64	74.65
			338.55

$S = \sqrt{\frac{338.55}{10}} = \sqrt{33.86} = 5.82$

$Sm = \frac{5.82}{3.32} = 1.75$

$\mu = 21.64 \pm (2.23)(1.75)$
$= 21.64 \pm 3.90$
$= 17.74$ to 25.54

Student Non-Access Means = 18.33

Student Access Accuracy Scores

X	$\bar{X}$	x	x^2
9	5.64	3.36	11.29
4	5.64	-1.64	2.69
5	5.64	- .64	.41
6	5.64	.36	.13
5	5.64	- .64	.41
3	5.64	-2.64	6.97
3	5.64	-2.64	6.97
9	5.64	3.36	11.29
9	5.64	3.36	11.29
6	5.64	.36	.13
3	5.64	-2.64	6.97
			58.55

$S = \sqrt{\frac{58.55}{10}} = \sqrt{5.86} = 2.42$

$Sm = \frac{2.42}{3.32} = .73$

$\mu = 5.64 \pm (2.23)(.73)$
$= 5.64 \pm 1.63$
$= 4.01$ to 7.27

Student Non-Access Means = 6.2

t test

Hypothesis 4

RP Above 84 Speed Scores

X	$\bar{X}$	x	x^2
19	18.5	.5	.25
28	18.5	9.5	90.25
15	18.5	-3.5	12.25
21	18.5	2.5	6.25
16	18.5	-2.5	6.25
15	18.5	-3.5	12.25
28	18.5	9.5	90.25
13	18.5	-5.5	30.25
17	18.5	-1.5	2.25
13	18.5	-5.5	30.25
			280.5

$S = \sqrt{\frac{280.5}{9}} = \sqrt{31.17} = 5.58$

$Sm = \frac{5.58}{3.16} = 1.77$

$\mu = 18.5 \pm (2.26)(1.77)$

$= 18.5 \pm 4$

$= 14.5$ to 22.5

RP Below 85 Mean = 20.5

RP Above 84 Accuracy Scores

X	$\bar{X}$	x	x^2
5	4.3	.7	.49
5	4.3	.7	.49
7	4.3	2.7	7.29
3	4.3	-1.3	1.69
6	4.3	1.7	2.89
5	4.3	.7	.49
4	4.3	- .3	.09
3	4.3	-1.3	1.69
3	4.3	-1.3	1.69
2	4.3	-2.3	5.29
			22.10

$S = \sqrt{\frac{22.10}{9}} = \sqrt{2.46} = 1.58$

$Sm = \frac{1.58}{3.16} = .5$

$\mu = 4.3 \pm (2.26)(.5)$

$= 4.3 \pm 1.13$

$= 3.17$ to 5.43

RP Below 85 Mean = 7

t test

Hypothesis 5

Piano Students Speed Scores

X	$\bar{X}$	x	x^2
28	21.5	6.5	42.25
21	21.5	-0.5	.25
16	21.5	-5.5	30.25
21	21.5	-0.5	.25
			73.00

$S = \sqrt{\frac{73}{3}} = \sqrt{24.33} = 4.93$

$Sm = \frac{4.93}{2.00} = 2.47$

$\mu = 21.5 \pm (3.18)(2.47)$

$= 21.5 \pm 7.85$

$= 13.65$ to 29.35

Non-Piano Students Mean = 19.41

Piano Students Accuracy Scores

X	$\bar{X}$	x	x^2
5	4	1	1
3	4	-1	1
6	4	2	4
2	4	-2	4
			10

$S = \sqrt{\frac{10}{3}} = \sqrt{3.33} = 1.82$

$Sm = \frac{1.82}{2.00} = .91$

$\mu = 4 \pm (3.18)(.91)$

$= 4 \pm 2.89$

$= 1.11$ to 6.89

Non-Piano Students Mean = 6.32

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